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Spectroscopy Diagnostics on the ZaP Flow Z-Pinch Experiment
C.S. ADAMS, U. SHUMLAK, B.A. NELSON, R.P. GOLINGO, S.L. JACKSON, Aerospace and Energetics Research Program, University of Washington — The ZaP Flow Z-Pinch Experiment investigates the stabilizing effects of sheared flow on plasma instabilities. Z-pinch stability is evaluated based on magnetic mode activity determined by arrays of magnetic probes. The pinch is considered to be quiescent when the value of the normalized m=1 mode is below a heuristic limit of 0.2. A suite of spectroscopic diagnostics determine the emissivity, temperature, and velocity characteristics of the Z-pinch. An Ion Doppler Spectrometer (IDS) determines the time evolution of the intensity, Doppler shift, and Doppler broadening of impurity ion emission, enabling the time evolution of the ion temperature and velocity to be calculated. An Intensified CCD (ICCD) spectrometer measures the spatial profile of the impurity ion radiation, enabling calculation of the velocity shear and radial dependence of the emissivity. Finally, a combination CCD/PMT spectrometer enables the determination of the evolution of the amplitude of a single spectral line as well as the time integrated emission of a range of wavelengths. Results from these diagnostics indicate a strong correlation between periods of quiescence, elevated plasma velocities, and velocity shear greater than the theoretical threshold of $v_z/a > 0.1kV_A$ required for stability. Furthermore, concurrent usage of these spectrometers has yielded consistent results from all three instruments.

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